Fit for a Rajah: While in Sarawak, North Borneo, Wallace was the guest of Sir James Brooke, the English adventurer who governed Sarawak as his own personal fiefdom. Wallace named a newly discovered butterfly in Brooke's honor, *Ornithoptera Brookiana* (currently *Trogonoptera brookiana*), noting in *The Malay Archipelago* that this is "one of the most elegant species known". (Image courtesy of Museum of Comparative Zoology, Harvard University.)

stock exchange; he argued against globalised free trade; an anti-imperialist, he preached "the rights of every people to govern themselves" [12].

The contrast with Darwin is striking. After publication of *The Origin*, Darwin's strategy was to consolidate and concretise the arguments laid out in his seminal work. His output remained resolutely scientific. One of the many reasons that Wallace has been so comprehensively eclipsed by Darwin in the standard telling of the evolution story may be that we prefer our scientists to stick to science. There is something laudably dedicated, almost puritanical, about Darwin's single-minded devotion to his scientific cause, whereas Wallace's scattershot embrace of every needy underdog under the sun smacks of dilettantism. We cringe at Wallace's more unfortunate choices — his endorsement of phrenology as "the true science of mind" [13], for instance — and wish he had followed Darwin's lead in staying true to science. But this may be the wrong reaction. Now, more than ever, we need scientists willing to become engaged in public ways with political and social issues. We need scientists willing to step outside the lab to talk about GMOs and about climate change; these topics are too important to be left in the hands of activists and politicians. Wallace was a brilliant scientist and, also, a passionate and engaged public intellectual. May he be a role model and an inspiration — perhaps one stripped of that enthusiasm for phrenology — for generations of scientists to come.

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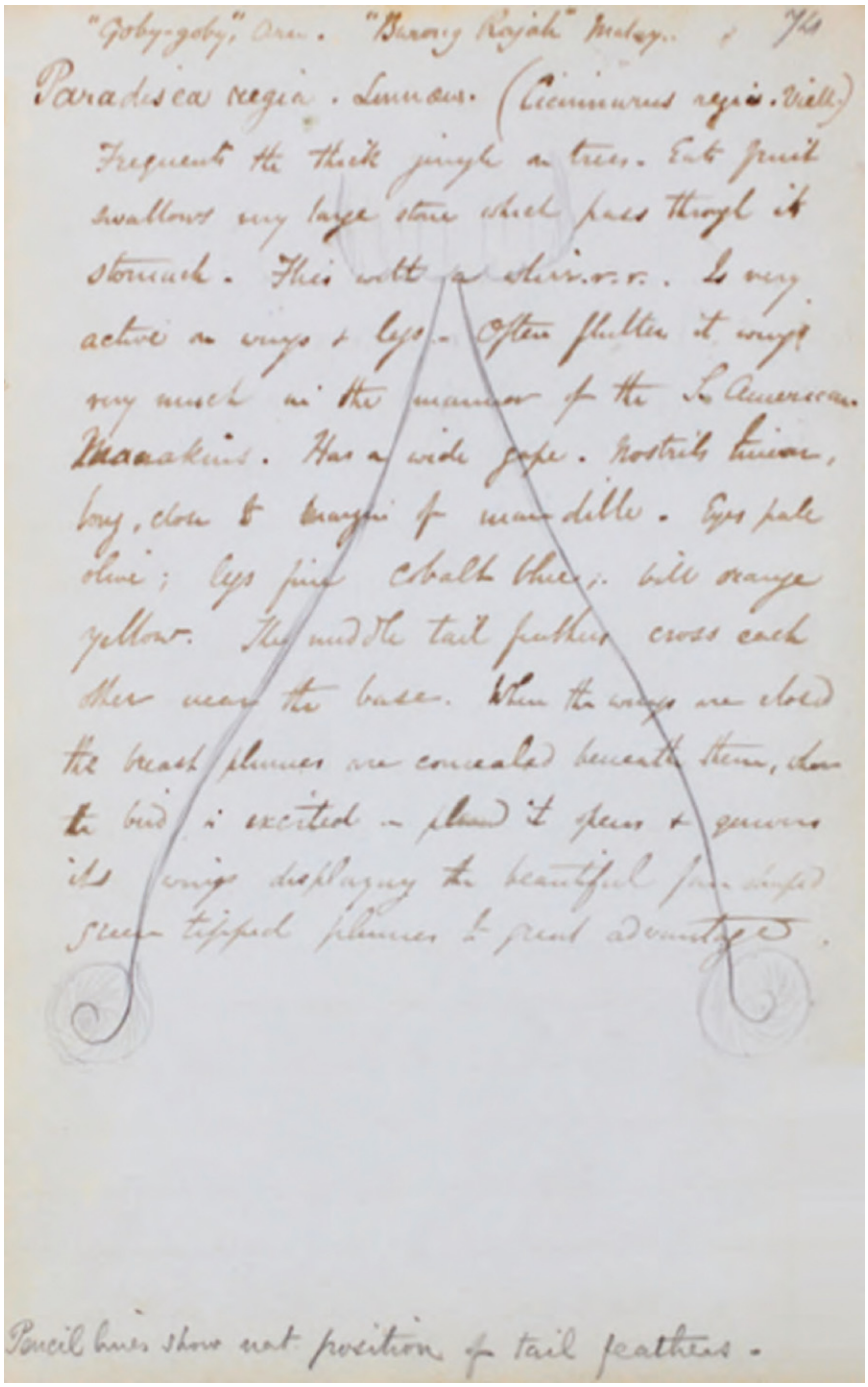
Wallace on the evolutionary trail

James T. Costa

When Alfred Russel Wallace described himself late in life as a "red-hot radical" he was referring to his campaigns as social reformer. However, his most significant scientific contributions were equally radical in their day, none more so than his early embrace of 'transmutation' (evolution, in modern terms). Wallace's eight years of travels in Southeast Asia (1854–1862) yielded an unprecedented bounty of specimens (with many species new to science) and detailed zoological, geographical, and ethnological observations recorded in a series of notebooks and journals. These provided rich source material for many of the approximately 60 papers and letters that Wallace published from the field in that period, as well as some of Wallace's most important later works, such as *The Malay Archipelago* [1] and *The Geographical Distribution of Animals* [2]. Several of Wallace's papers explore topics related to his overriding interest in the 'species question' — the nature of species and varieties, and the idea of transmutation. Understanding the origin of species and varieties was one of the main motivators for Wallace's travels in South America and Southeast Asia (e.g., Wallace Correspondence Project [3], letters WCP345, WCP346, WCP348). One notebook from this period in particular stands out in articulating his interest far more explicitly than the circumspect language found in most of his published writings.

Linnean Society of London manuscript No. 180, labeled the 'Species Notebook' by the late historian of science H. Lewis McKinney [4], spans the years 1855 to about 1860. Recently published for the first time in facsimile with transcription and commentary [5], this notebook is remarkable for its extensive narrative in which Wallace recorded evidence and constructed arguments for transmutation, aiming at the same time to demolish the leading anti-transmutation arguments of the day, put forward by geologist Charles Lyell in his seminal *Principles of Geology* [6]. Lyell, the preeminent naturalist of Britain, devoted much of the second volume of the *Principles* to undermining the idea of species change, and his anti-transmutation



Paradise recorded: Wallace kept several notebooks during his travels, including what has come to be called the 'Species Notebook' in which he recorded both thoughts and observations. Paper was expensive and, for an itinerant naturalist, heavy, so Wallace often economized by putting a single to page to multiple uses. Here is both his account of the king bird of paradise, *Cicinnurus regius*, and his sketch, overlaid, of the configuration of its tail feathers. (By permission of the Linnean Society of London; www.linnean.org.)

arguments were taken as definitive. To successfully argue for transmutation thus meant refuting Lyell's eloquent arguments. Accordingly, many entries in the Species Notebook, including a long narrative section of 24 pages, are explicitly aimed at Lyell with arguments from the fourth edition of the *Principles* copied out followed by Wallace's rebuttals.

Noteworthy among these entries is one revealing Wallace's plans for a book on evolution with Lyell as foil: the comment "introduce this and disprove all Lyell's arguments first at the commencement of my last chapter" follows a passage in which Wallace criticizes Lyell's inconsistency in embracing gradual change by natural law in the inorganic world, while rejecting it for the organic world [5]. A "last chapter" implies several chapters, i.e., a book, a reference that resonates with a comment Wallace made in a letter to his friend and earlier traveling companion Henry Walter Bates. Bates had written from Amazonia to compliment Wallace on his 1855 'Sarawak law' paper — to date the most compelling case for transmutation. Replying in early 1858, Wallace wrote: "To persons who have not thought much on the subject, I fear my paper on the succession of species will not appear so clear as it does to you... That paper is, of course, only the announcement of the theory, not its development. I have prepared the plan & written portions of an extensive work embracing the subject in all its bearings & endeavouring to provide what in the paper I have only indicated" (WCP366) [3]. In his "extensive work" Wallace meant to rebut Lyell and build on the central argument of the 1855 paper, namely, that related species tend to be proximate in space and time, suggesting that new species somehow derive from pre-existing ones. His book was not to be, regrettably, owing to the events of 1858 and Darwin's publication of *On the Origin of Species* the following year. Wallace was happy to defer to Darwin, and quietly abandoned his book plan.

The tack Wallace would have taken in his book is evident from the Species Notebook. He was constructing a 'consilience' argument, *sensu* Whewell [7], tying together disparate lines of evidence in favor of transmutation: fossils (noting their succession over time and that "each group goes on progressing after other groups have branched from it [and] then go on in parallel or diverging series"); island biogeography (in particular, the significance of endemism, isolation, the relationship of island species to those of the nearest mainland, and the importance of island antiquity for speciation); embryology (pointing out that characters evident in early development can be used to inform classification, reflecting what we now

term the common ancestral state of members of a group); morphology (arguing that the "natural inference of an unprejudiced person" is to recognize that homologous structures "are true records of the progress of the organic world); domestication (maintaining that divergent animal breeds constitute evidence of mutability, and offering thought experiments to show that there is no good reason to think that domesticated varieties cannot continue to vary and diverge indefinitely); and design and adaptation (noting examples where species with identical structure have divergent habits, and offering fierce critiques of prevailing arguments for good design in nature).

Frustratingly, there are also gaps. There is nothing on the 'struggle for existence' in the Species Notebook, or on Wallace's February 1858 discovery of natural selection, which came to him in a flash of insight in a fevered state. The Species Notebook nonetheless offers an unparalleled window into the train of Wallace's evolutionary thinking pre-1858/1859. His transmutation book was not to be, but the notebook is a compelling proxy; through it we clearly see a deeply creative Wallace, pursuing lines of evidence in support of an evolutionary vision at once remarkably modern, and strikingly congruent with Darwin's own consilience approach seen in the *Origin*.

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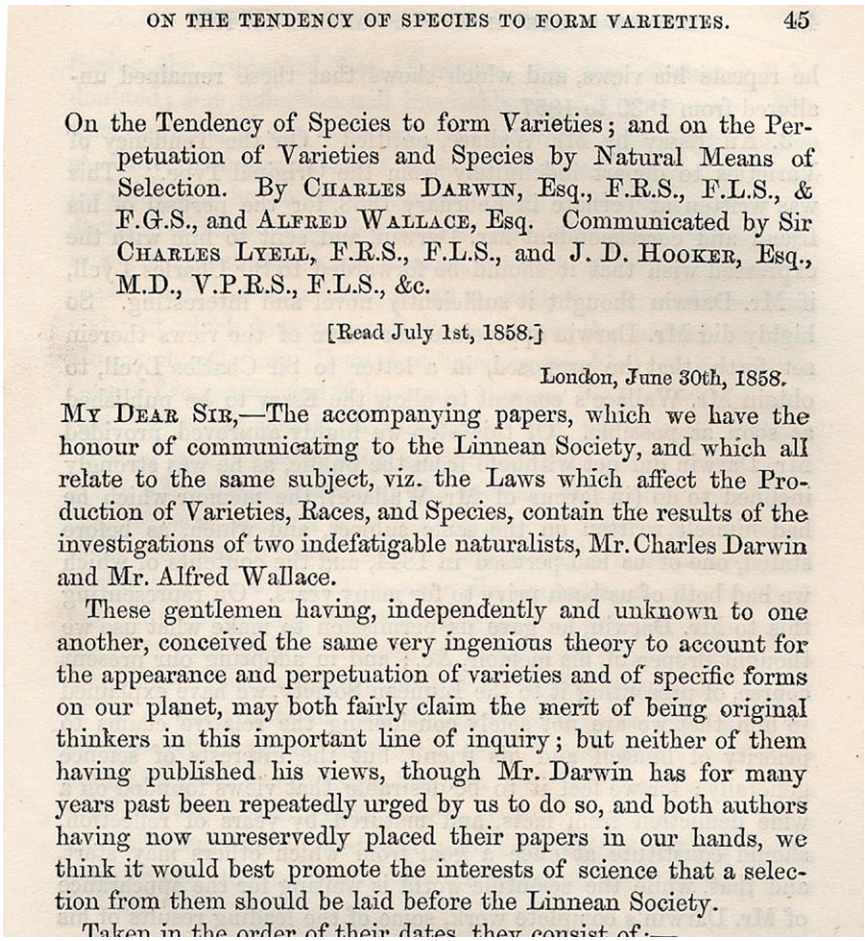
Wallace and Darwin

Janet Browne

The scientific friendship between Alfred Russel Wallace and Charles Darwin has become one of the most famous relationships in the history of science. It could so easily have degenerated into an ugly priority dispute after Wallace's surprising letter to Darwin from Ternate in 1858, in which Wallace outlined his own theory of evolution by natural selection; yet, the relationship was characterized throughout by personal generosity and high scientific esteem. No two authors thrown together in such a fashion tried harder than Darwin and Wallace to treat each other fairly. Wallace greatly admired *On the Origin of Species*. In turn, Darwin regarded Wallace as the one man who truly understood the idea of evolution by natural selection.

They did not, however, always agree. Some ten years after their joint paper at the Linnean Society they would diverge markedly in their theories of human evolution. Wallace also disputed Darwin's concept of sexual selection, contending that female birds were less brightly colored than males because the dull colour would give them protection from predators and hence possessed survival value. The extent to which they later diverged on the question of spiritualism is well illustrated by a court case in 1876 in which a prominent spiritualist medium, Henry Slade, was prosecuted as a fraud. Wallace appeared as a witness for the defence; Darwin contributed £10 to the costs of the prosecution.



ON THE TENDENCY OF SPECIES TO FORM VARIETIES. 45

On the Tendency of Species to form Varieties; and on the Perpetuation of Varieties and Species by Natural Means of Selection. By CHARLES DARWIN, Esq., F.R.S., F.L.S., & F.G.S., and ALFRED WALLACE, Esq. Communicated by Sir CHARLES LYELL, F.R.S., F.L.S., and J. D. HOOKER, Esq., M.D., V.P.R.S., F.L.S., &c.

[Read July 1st, 1858.]

London, June 30th, 1858.

MY DEAR SIR,—The accompanying papers, which we have the honour of communicating to the Linnean Society, and which all relate to the same subject, viz. the Laws which affect the Production of Varieties, Races, and Species, contain the results of the investigations of two indefatigable naturalists, Mr. Charles Darwin and Mr. Alfred Wallace.

These gentlemen having, independently and unknown to one another, conceived the same very ingenious theory to account for the appearance and perpetuation of varieties and of specific forms on our planet, may both fairly claim the merit of being original thinkers in this important line of inquiry; but neither of them having published his views, though Mr. Darwin has for many years past been repeatedly urged by us to do so, and both authors having now unreservedly placed their papers in our hands, we think it would best promote the interests of science that a selection from them should be laid before the Linnean Society.

Taken in the order of their dates, they consist of:—

Natural selection unveiled: The print version of the double announcement of evolution by natural selection by Charles Darwin and Alfred Russel Wallace at the Linnean Society on 1 July 1858. It was presented by Charles Lyell and Joseph Hooker. Neither Darwin nor Wallace was present at the meeting: Darwin was at home burying his infant son and Wallace was languishing sick in a hut in New Guinea. (By permission of the Linnean Society of London; www.linnean.org.)